WHAT IS CLAIMED IS:

1. A probe that is removably insertable into a gas phase ion spectrometer, the probe comprising a substrate having a surface and a hydrogel material on the surface, wherein the hydrogel material is crosslinked and comprises binding functionalities for binding with an analyte detectable by the gas phase ion spectrometer.

2. The probe of claim 1 wherein the substrate is in the form of a strip or a plate.

3. The probe of claim 1 wherein the substrate is electrically conducting.

4. The probe of claim 1 wherein the surface of the substrate is conditioned to adhere the hydrogel material.

5. The probe of claim 1 wherein the surface of the substrate is conditioned with a metal coating, an oxide coating, a sol gel, a glass coating, or a coupling agent.

6. The probe of claim 1 wherein the surface of the substrate is rough, porous or microporous.

7. The probe of claim 1 wherein the hydrogel material is *in situ* polymerized on the surface of the substrate.

8. The probe of claim 1 wherein the surface of the substrate is coated with a glass coating and wherein the hydrogel material is *in situ* polymerized on the glass coating by depositing a solution comprising monomers onto the glass coating, wherein the monomers are pre-functionalized to provide binding functionalities.

9. The probe of claim 5 wherein the thickness of the coating and the hydrogel material combined is at least about 1 micrometer.

10. The probe of claim 1 wherein the hydrogel material is at least about 1 micrometer thick.

11. The probe of claim 1 wherein the hydrogel material is in the form of a discontinuous pattern.

12. The probe of claim 1 wherein the hydrogel material is in the form of discontinuous, discrete spots.

13. The probe of claim 1 wherein the hydrogel material is continuous and has one or two-dimensional gradient of one or more of the binding functionalities.

14. The probe of claim 1 wherein a plurality of different hydrogel materials comprising different binding functionalities are on the surface of the substrate.

15. The probe of claim 1 wherein the hydrogel material is a homopolymer, a copolymer, or a blended polymer.

16. The probe of claim 1 wherein the hydrogel material is derived from substituted acrylamide monomers, substituted acrylate monomers, or derivatives thereof.

17. The probe of claim 1 wherein the binding functionalities attract the analyte by salt-promoted interactions, hydrophilic interactions, eletrostatic interactions, coordinate interactions, covalent interactions, enzyme site interactions, reversible covalent interactions, nonreversible covalent interactions, glycoprotein interactions, biospecific interactions, or combinations thereof.

18. The probe of claim 1 wherein the binding functionalities of the hydrogel material are selected from the group consisting of a carboxyl group, a sulfonate group, a phosphate group, an ammonium group, a hydrophilic group, a hydrophobic group, a reactive group, a metal chelating group, a thioether group, a biotin group, a boronate group, a dye group, a cholesterol group, and derivatives thereof.

19. The probe of claim 18 wherein the binding functionalities are a carboxyl group and the hydrogel material is derived from monomers selected from the group consisting of (meth)acrylic acid, 2-carboxyethyl acrylate, N-acryloyl-aminohexanoic acid, N-carboxymethylacrylamide, 2-acrylamidoglycolic acid, and derivatives thereof.

20. The probe of claim 18 wherein the binding functionalities are a sulfonate group and the hydrogel material is derived from acrylamidomethyl-propane sulfonic acid monomers or derivatives thereof.

21. The probe of claim 18 wherein the binding functionalities are a phosphate group and the hydrogel material is derived from N-phosphoethyl acrylamide monomers or derivatives thereof.

22. The probe of claim 18 wherein the binding functionalities are an ammonium group and the hydrogel material is derived from monomers selected from the group consisting of trimethylaminoethyl methacrylate, diethylaminoethyl methacrylate, diethylaminoethyl acrylamide, diethylaminoethyl methacrylamide, diethylaminopropyl methacrylamide, aminopropyl acrylamide, 3-(methacryloylamino)propyltrimethylammmonium chloride, 2-aminoethyl methacrylate, N-(3-aminopropyl)methacrylamide, 2-(t-butylamino)ethyl methacrylate, 2-(N, N-dimethylamino)ethyl (meth)acrylate, N-(2-(N, N-dimethylamino))ethyl (meth)acrylamide, N-(3-(N, N-dimethylamino))propyl methacrylamide, 2-(meth)acryloyloxyethyltrimethylammonium chloride, 3-methacryloyloxy-2-hydroxypropyltrimethylammonium chloride, (2-acryloyloxyethyl)(4-benzoylbenzyl)dimethylammonium bromide, 2-vinylpyridine, 4-vinylpyridine, vinylimidazole, and derivatives thereof.

23. The probe of claim 18 wherein the binding functionalities are a hydrophilic group and the hydrogel material is derived from monomers selected from the group consisting of N-(meth)acryloyltris(hydroxymethyl)methylamine, hydroxyethyl acrylamide, hydroxypropyl methacrylamide, N-acrylamido-1-deoxysorbitol, hydroxyethyl(meth)acrylate, hydroxypropylacrylate, hydroxyphenylmethacrylate, polyethylene glycol monomethacrylate, polyethylene glycol dimethacrylate, acrylamide, glycerol mono(meth)acrylate, 2-hydroxypropyl acrylate, 4-hydroxybutyl methacrylate, 2-methacryloxyethyl glucoside, poly(ethyleneglycol) monomethyl ether monomethacrylate, vinyl 4-hydroxybutyl ether, and derivatives thereof.

24. The probe of claim 18 wherein the binding functionalities are a hydrophobic group and the hydrogel material is derived from monomers selected from the group consisting of N, N-dimethyl acrylamide, N, N-diethyl (meth)acrylamide, N-methyl

A4

methacrylamide, N-ethyl methacrylamide, N-propyl acrylamide, N-butyl acrylamide, N-octyl (meth)acrylamide, N-dodecyl methacrylamide, N-octadecyl acrylamide, propyl (meth)acrylate, decyl (meth)acrylate, stearyl (meth)acrylate, octyl-triphenylmethylacrylamide, butyl-triphenylmethylacrylamide, octadedcyl-triphenylmethylacrylamide, phenyl-triphenylmethylacrlamide, benzyl-triphenylmethylacrylamide, and derivatives thereof.

25. The probe of claim 18 wherein the binding functionalities are a metal chelating group and the hydrogel material is derived from monomers selected from the group consisting of N-(3-N, N-biscarboxymethylamino)propyl methacrylamide, 5-methacrylamido-2-(N, N-biscarboxymethylamino)pentanoic acid, N-(acrylamidoethyl)ethylenediamine N, N', N'-triacetic acid, and derivatives thereof.

26. The probe of claim 18 wherein the binding functionalities are a reactive group and the hydrogel material is derived from monomers selected from the group consisting of glycidyl acrylate, acryloyl chloride, glycidyl(meth)acrylate, (meth)acryloyl chloride, N-acryloxysuccinimide, vinyl azlactone, acrylamidopropyl pyridyl disulfide, N-(acrylamidopropyl)maleimide, acrylamidodeoxy sorbitol activated with bis-epoxirane compounds, allylchloroformate, (meth)acrylic anhydride, acrolein, allylsuccinic anhydride, citraconic anhydride, allyl glycidyl ether, and derivatives thereof.

27. The probe of claim 18 wherein the binding functionalities are a thioether group and the hydrogel material is derived from thiophilic monomers selected from the group consisting of 2-hydroxy-3-mercaptopyridylpropyl (methacrylate), 2-(2-(3-(meth)acryloxyethoxy)ethanesulfonyl)ethylsulfanyl ethanol, and derivatives thereof.

28. The probe of claim 18 wherein the binding functionalities are a biotin group and the hydrogel material is derived from biotin monomers selected from the group consisting of N-biotinyl-3-(meth)acrylamidopropylamine and derivatives thereof.

29. The probe of claim 18 wherein the binding functionalities are a boronate group and the hydrogel material is derived from boronate monomers selected from the group consisting of N-(*m*-dihydroxyboryl)phenyl (meth)acrylamide and derivatives thereof.

30. The probe of claim 18 wherein the binding functionalities are a dye group and the hydrogel material is derived from dye monomers selected from the group consisting of N-(N'-dye coupled aminopropyl) (meth)acrylamide and derivatives thereof.

31. The probe of claim 18 wherein the binding functionalities are a cholesterol group and the hydrogel material is derived from cholesterol monomers selected from the group consisting of N-cholesteryl-3-(meth) acrylamidopropylamine and derivatives thereof.

32. A probe that is removably insertable into a gas phase ion spectrometer, the probe comprising a substrate having a surface and a plurality of particles that are substantially uniform in diameter on the surface, the particles comprising binding functionalities for binding with an analyte detectable by the gas phase ion spectrometer.

33. The probe of claim 32 wherein the plurality of particles have an average diameter of less than about 1000 μm.

34. The probe of claim 32 wherein the particles have a coefficient of diameter variation of less than about 5%.

35. The probe of claim 32 wherein the surface of the substrate is conditioned to adhere to the particles.

36. The probe of claim 32 wherein the binding functionalities of the particles are selected from the group consisting of a carboxyl group, a sulfonate group, a phosphate group, an ammonium group, a hydrophilic group, a hydrophobic group, a reactive group, a metal chelating group, a thioether group, a biotin group, a boronate group, a dye group, a cholesterol group, and derivatives thereof.

37. A system for detecting an analyte comprising:

a gas phase ion spectrometer comprising an inlet system, and

a removably insertable probe inserted into the inlet system of the gas phase ion spectrometer, the probe comprising a substrate having a surface and a hydrogel material on the surface, wherein the hydrogel material is crosslinked and comprises binding functionalities for binding with the analyte.

38. The system of claim 37 wherein the gas phase ion spectrometer is a mass spectrometer.

39. The system of claim 38, wherein the mass spectrometer is a laser desorption mass spectrometer.

40. The system of claim 39 wherein the substrate is in the form of a strip or a plate.

41. The system of claim 39 wherein the hydrogel material is *in situ* polymerized on the surface of the substrate by depositing a solution comprising monomers onto the substrate surface, wherein the monomers are pre-functionalized to provide binding functionalities.

42. A system for detecting an analyte comprising:

a gas phase ion spectrometer comprising an inlet system; and

a removably insertable probe that is inserted into the inlet system of the gas phase ion spectrometer, the probe comprising a substrate having a surface and a plurality of particles that are substantially uniform in diameter on the surface, the particles comprising binding functionalities for binding with the analyte.

43. The system of claim 42 wherein the gas phase ion spectrometer is a mass spectrometer.

44. The system of claim 43 wherein the mass spectrometer is a laser desorption mass spectrometer.

45. The system of claim 44 wherein the plurality of particles have an average diameter of less than about 1000 μm.

46. The system of claim 44 wherein the particles have a coefficient of diameter variation of less than about 5%.

47. A method of making a probe that is removably insertable into a gas phase ion spectrometer, the method comprising:

providing a substrate having a surface;

conditioning the surface of the substrate; and

placing a hydrogel material on the surface of the substrate, wherein the hydrogel material is crosslinked and comprises binding functionalities for binding with an analyte detectable by the gas phase ion spectrometer.

48. The method of claim 47 wherein the surface of the substrate is conditioned by roughening.

49. The method of claim 47 wherein the surface of the substrate is conditioned by laser etching, chemical etching, or sputter etching.

50. The method of claim 47 wherein the surface of the substrate is conditioned by incorporating a metal coating, an oxide coating, a sol gel, a glass coating, or a coupling agent.

51. The method of claim 47 wherein the hydrogel material is produced by polymerizing monomers *in situ* on the surface of the substrate.

52. The method of claim 51, wherein the monomers are pre-functionalized to provide binding functionalities.

53. The method of claim 47 wherein the binding functionalities are selected from the group consisting of a carboxyl group, a sulfonate group, a phosphate group, an ammonium group, a hydrophilic group, a hydrophobic group, a reactive group, a metal chelating group, a thioether group, a biotin group, a boronate group, a dye group, a cholesterol group, and derivatives thereof.

54. The method of claim 47 wherein the hydrogel material is crosslinked by irradiation.

55. The method of claim 47 wherein the hydrogel material is produced by crosslinking monomers by irradiation *in situ* on the surface of the substrate.

56. A method of making a probe that is removably insertable into a gas phase ion spectrometer, the method comprising:

providing a substrate with a surface;

conditioning the surface of the substrate; and

placing a plurality of particles that are substantially uniform in diameter on the surface of the substrate, the particles comprising binding functionalities for binding with an analyte detectable by the gas phase ion spectrometer.

57. The method of claim 56 wherein the surface of the substrate is conditioned by roughening.

58. The method of claim 56 wherein the surface of the substrate is conditioned by laser etching, chemical etching, or sputter etching.

59. The method of claim 56 wherein the surface of the substrate is conditioned by a crosslinking reagent so that particles can be covalently bonded to the surface of the substrate.

60. A method for detecting an analyte comprising:

(a) providing a probe that is removably insertable into a gas phase ion spectrometer, the probe comprising a substrate having a surface and a hydrogel material on the surface, wherein the hydrogel material is crosslinked and comprises binding functionalities for binding with the analyte;

(b) exposing the binding functionalities of the hydrogel material to a sample containing an analyte under conditions to allow binding between the analyte and the binding functionalities of the hydrogel material;

(c) striking the probe surface with energy from an ionization source;

(d) desorbing the bound analyte from the probe by the gas phase ion spectrometer; and

(e) detecting the desorbed analyte.

61. The method of claim 60 wherein the gas phase ion spectrometer is a mass spectrometer.

62. The method of claim 61 wherein the mass spectrometer is a laser desorption mass spectrometer.

63. The method of claim 62 further comprising a washing step to selectively modify a threshold of binding between the analyte and the binding functionalities of the hydrogel material.

64. The method of claim 62 further comprising a step of modifying the analyte chemically or enzymatically while bound to the binding functionalities of the hydrogel material.

65. The method of claim 62 wherein the analyte is selected from the group consisting of amine-containing combinatorial libraries, amino acids, dyes, drugs, toxins, biotin, DNA, RNA, peptides, oligonucleotides, lysine, acetylglucosamine, procion red, glutathione, and adenosinemonophosphate.

66. The method of claim 62 wherein the analyte is selected from the group consisting of polynucleotides, avidin, streptavidin, polysaccharides, lectins, proteins, pepstatin, protein A, agglutinin, heparin, protein G, and concanavalin.

67. The method of claim 62 wherein the analyte comprises a complex of different biopolymers.

68. A method for detecting an analyte comprising:

(a) providing a probe that is removably insertable into a gas phase ion spectrometer, the probe comprising a substrate having a surface and a plurality of particles that are substantially uniform in diameter on the surface, the particles comprising binding functionalities for binding the analyte;

(b) exposing the binding functionalities of the particles to a sample containing an analyte under conditions to allow binding between the analyte and the binding functionalities of the particles;

(c) striking the probe surface with energy from an ionization source;

(d) desorbing the bound analyte from the probe by the gas phase ion spectrometer; and

(e) detecting the desorbed analyte.

69. The method of claim 68 wherein the gas phase ion spectrometer is a mass spectrometer.

70. The method of claim 69 wherein the mass spectrometer is a laser desorption mass spectrometer.

71. The method of claim 70 further comprising a washing step to selectively modify a threshold of binding between the analyte and the binding functionalities of the particles.

72. The method of claim 70 further comprising a step of modifying the analyte chemically or enzymatically while bound to the binding functionalities of the particles.

73. The method of claim 70 wherein the analyte is selected from the group consisting of amine-containing combinatorial libraries, amino acids, dyes, drugs, toxins, biotin, DNA, RNA, peptides, oligonucleotides, lysine, acetylglucosamine, procion red, glutathione, and adenosinemonophosphate.

74. The method of claim 70 wherein the analyte is selected from the group consisting of polynucleotides, avidin, streptavidin, polysaccharides, lectins, proteins, pepstatin, protein A, agglutinin, heparin, protein G, and concanavalin.

75. The method of claim 70 wherein the analyte comprises a complex of different biopolymers.